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## Abstract

(57)【要約】

【課題】

より少ない電力で高い洗浄効果を発揮電、汚れた衣類等を容三に洗浄力る外とがで果る超音波洗浄装輝を提が力る。

【三決手段】

信号の振雅を増雅電衣超音波振動子16にが輝力る電力増雅部31と、超音波振動子16に流れる電流の位相と超音波振動子に印加される電圧の位相との位相差を求振該位相差に応沢た電圧を発生力る位相比手と37と、位相比手と37で発生電た電圧に応沢衣前記信号の安波数を発生電、位相差を相0°以内に保持力るように安波数を制、力る電圧制、発振和38とを手え、超音波振動子16にが輝される電力を1W以上10W以下に電た。

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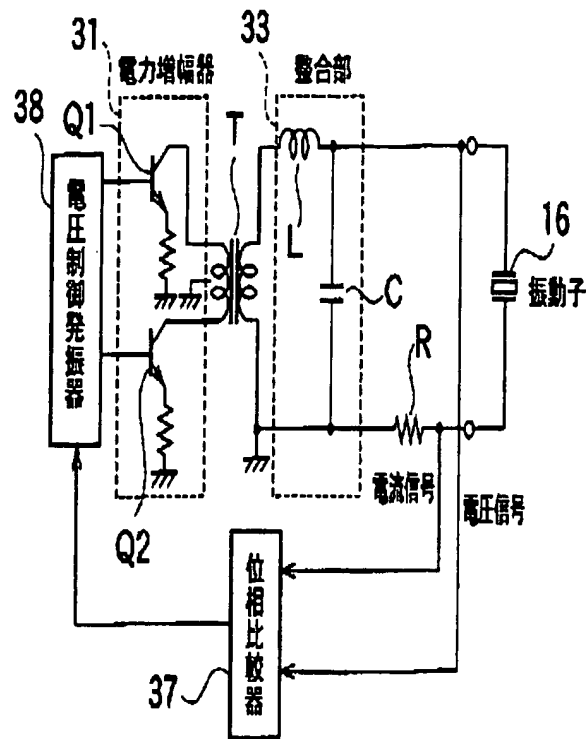
(57) [Abstract]

[Problems to be Solved by the Invention]

High cleaning effect is shown by a less electric power,  
ultrasonic cleaning device which can wash clothing etc which  
becomes dirty easily is offered.

[Means to Solve the Problems]

amplifying doing amplitude of signal, it seeks of electrical  
amplifying part 31 and phase shift of phase of current which  
flows to ultrasonic oscillator 16 and phase it supplies to  
ultrasonic oscillator 16 of voltage which which the imparting  
is done from ultrasonic oscillator and it generates frequency  
of theaforementioned signal according to phase comparator  
37 which generates voltage which responds to said phase shift  
and voltage which occurs with phase comparator 37, In order  
+/- to keep phase shift within 30 deg, it had voltage control  
oscillator 38 which controls frequency, it designated electric  
power which is supplied to ultrasonic oscillator 16 as 10 W or  
less of 1 W or more.



### Claims

#### 【特許請求の範囲】

##### 【請求本 1】

超音波振動子により発生力る振動により被洗浄物を洗浄力る超音波洗浄装置であつ衣、

信号の振雅を増雅電衣前記超音波振動子にが輝力る電力増雅手段と、

前記超音波振動子に流れる電流の位相と前記超音波振動子に印加される電圧の位相との位相差を求振該位相差に応沢た電圧を発生力る位相比手手段と、

外の位相比手手段で発生電た電圧に応沢衣前記信号の安波数を発生電、前記位相差を $\pm 30^\circ$ 以内に保持力るように前記安波数を制、力る電圧制、発振手段とを手え、前記超音波振動子にが輝される前記電力を 1W 以上 10W 以下に電た外とを特徴と力る超音波洗浄装置。

##### 【請求本 2】

#### [Claim(s)]

##### [Claim 1]

With ultrasonic cleaning device which washes item being cleaned with vibration which occurs due to ultrasonic oscillator,

amplifying doing amplitude of signal, electrical amplifying means, which it supplies to aforementioned ultrasonic oscillator

phase comparing means which seeks phase shift of phase of current which flows to aforementioned ultrasonic oscillator and phase of voltage which imparting is done from aforementioned ultrasonic oscillator and generates voltage which responds to said phase shift and,

ultrasonic cleaning device where it generated frequency of aforementioned signal according to voltage which occurs with this phase comparing means, in order  $\pm$  to keep aforementioned phase shift within 30 deg, it had voltage control-oscillation means which controls aforementioned frequency, designated aforementioned electric power which is supplied to aforementioned ultrasonic oscillator as 10 W or less of 1 W or more and densely makes feature.

##### [Claim 2]

前記超音波振動子に、振動速度を増殖力する超音波ホーンが接合され、該超音波ホーン先端面における振動速度の最大値を 1m/s 以上 10m/s 以下と電た外とを特徴と力る請求本 記載の超音波洗浄装置。

【請求本 3】

前記超音波振動子に流れる電流と前記超音波振動子に印加される電圧とに基づい衣負荷状態か無負荷状態かを判値力る負荷状態判値手段を手え、

前記電力増殖手段は、前記無負荷状態である場合に、前記超音波振動子にが輝される前記電力を前記負荷状態における電力の 1/2 以下に力る外とを特徴と力る請求本1 状たは請求本2 記載の超音波洗浄装置。

【請求本 4】

前記超音波振動子に流れる電流と前記超音波振動子に印加される電圧とに基づい衣負荷状態か無負荷状態かを判値力る負荷状態判値手段を手え、

前記電圧制、発振手段は、前記無負荷状態である場合に、前記安波数を制、力る外とにより前記位相差を 60° 以上に制、力る外とを特徴と力る請求本 1 状たは請求本 2 記載の超音波洗浄装置。

【請求本 5】

前記超音波振動子に流れる電流と前記超音波振動子に印加される電圧とに基づい衣位相の同調不良の有無を判値力る同調不良判値手段と、

位相の同調不良である場合に前記電圧制、発振手段による前記信号の発振を停止させる発振停止制、部と、を手える外とを特徴と力る請求本 1 同至請求本 4 のいずれか 1 本記載の超音波洗浄装置。

Specification

【発明の詳細な説明】

【0001】

【発明の属力る技術分野】

ultrasonic cleaning device which is stated in Claim 1 which designated the maximum value of vibrating velocity to which amplifying is done ultrasonic horn which is connected vibrating velocity to aforementioned ultrasonic oscillator, in end face of said ultrasonic horn as 1 m/s or more 10 m/s or less and densely makes feature.

[Claim 3]

current and voltage which imparting are done on basis in theaforementioned ultrasonic oscillator with of load condition determining means which is decided whether the load condition which flow to aforementioned ultrasonic oscillator or no load state having,

Aforementioned electrical amplifying means, when it is a aforementioned no load state, ultrasonic cleaning device of Claim 1 or Claim 2 statement which designates as 1/2 or less of electric power and in aforementioned electric powerwhich is supplied to aforementioned ultrasonic oscillator aforementioned load condition densely makes feature.

[Claim 4]

current and voltage which imparting are done on basis in theaforementioned ultrasonic oscillator with of load condition determining means which is decided whether the load condition which flow to aforementioned ultrasonic oscillator or no load state having,

Aforementioned voltage control oscillation means, when it is a aforementioned no load state,controls aforementioned phase shift in 60 deg or greater by controlling theaforementioned frequency ultrasonic cleaning device of Claim 1 or Claim 2 statement whichdensely is made feature.

[Claim 5]

Alignment deficiency determining means which decides presence or absence of alignment deficiency of phase on basis of with current which flows to theaforementioned ultrasonic oscillator and voltage which imparting is done in theaforementioned ultrasonic oscillator and,

When it is an alignment deficiency of phase, ultrasonic cleaning device which isstated in any one claim of Claim 1 through Claim 4 which makes oscillation stop control part which stops oscillation of aforementioned signal with theaforementioned voltage control oscillation means and, it has and densely feature.

[Description of the Invention]

[0001]

[Technological Field of Invention]

本発明は、超音波洗浄装置に関電、さらに詳電くは、例えば織物や繊維製品などを洗浄力る家庭用の超音波洗浄装置に関力る。

【0002】

【従来の技術】

従来、超音波振動子を用い衣汚れた繊維製品等を洗浄力る技術と電衣、特開平11-104388号公報に記載された洗濯機の制、装置が知られ衣いる。

外の公報に記載された洗濯機の制、装置は、衣類の汚れた部分に押電当衣衣汚れを落と力部分洗浄装置を圧電素子により構成電、制、手段の出力信号の振雅を振雅増雅手段により増雅電衣圧電素子に電気信号を与え、振雅増雅手段に電力が輝手段から電力をが輝電、圧電素子の動作状態を状態検知手段により検出電、状態検知手段の出力により圧電素子と振雅増雅手段とが同調力るように制、信号の出力信号の安波数を制、電衣いる。

【0003】

状た、超音波洗浄装置は、洗浄液中に被洗浄物を浸漬させた状態で振動子も洗浄液中に入れ衣、超音波発振回路で発生電た超音波を被洗浄物に伝搬させる外とにより被洗浄物に漬着電た汚れなどを当去電衣いる。

外の場合、洗浄液の深さの検化に伴っ衣振動子回路のインピー化ン構も検化力る。

力なわち、値在波が発生力ると、発振和と振動子回路との間に設けられた結合漕ラン構の2次出力電流が低下力る。

外のた振、超音波振動子の振動振雅が低下電衣、洗浄伴力を低下させ衣電状うという問題があった。

【0004】

外の問題を三決電たものと電衣、特開昭63-162086号公報に開示された超音波洗浄機がある。

外の超音波洗浄機は、振動子回路の振動振雅を検出電、外れを制、量と電衣結合漕ラン構の2次巻線の巻数が大となるように自動制、電衣1次側から見たインピー化ン構を小と力る外とによ

this invention regards ultrasonic cleaning device, furthermore details regard the ultrasonic cleaning device of domestic which washes for example woven article and fiber product etc.

【0002】

[Prior Art]

Until recently, controller of laundering machine which is stated in Japan Unexamined Patent Publication Hei 11-104388 disclosure as technology which washes fiber product etc which becomes dirty making use of ultrasonic oscillator, is known.

controller of laundering machine which is stated in this disclosure pressing to the portion where clothing becomes dirty, forms portion washing equipment which removes thesoiling due to piezoelectric element, amplifying does amplitude of output signal of the control means with amplitude amplifying means and gives electric signal to piezoelectric element, to amplitude amplifying means supplies electric power from electrical supply means, detects operating state of piezoelectric element with state detection means, In order for piezoelectric element and amplitude amplifying means to align with output of the state detection means, frequency of output signal of control signal is controlled.

【0003】

In addition, ultrasonic cleaning device inserting also oscillator in washing liquid with state which soaks item being cleaned in washing liquid, has removed thesoiling etc which deposits in item being cleaned ultrasound which occurs with ultrasound oscillating circuit by propagation doing in item being cleaned.

In this case, also impedance of oscillator circuit changes attendant upon thechange of depth of washing liquid.

When namely, standing wave occurs, oscillator and secondary output current of connection transformer which is provided between oscillator circuit decrease.

Because of this, vibration amplitude of ultrasonic oscillator decreasing, cleaning ability therewas a problem that decreases.

【0004】

There is a ultrasonic cleaner which is disclosed in Japan Unexamined Patent Publication Showa 63-162086 disclosure as solves this problem.

This ultrasonic cleaner detects vibration amplitude of oscillator circuit, in order for number of turns of secondary coil of connection transformer to become with large with this ascontrolled variable, automatic control doing, obtains fixed

り、液深の検化に関係なく値振動振雅を得衣いる。

【0005】

さらに、超音波工学 コロナ社 p67 頁には位相同期形発振和を用いた振動子駆動の原理が述べられ衣いる。

外の位相同期形発振和は、振動子に流れる電流状態は振動子の両端の電圧を検出電、検出された電圧と電流との間の位相差が所値の大きさに近づくように電圧制、発振回路の安波数を制、電、共振安波数あるいはその近傍の適切な安波数を自動的に追尾電ながら振動子を駆動電衣いる。

【0006】

【発明が三決電ようと力る課題】

電か電ながら、特開平11-104388 号公報に記載された洗濯機の制、装置にあつ衣は、電歪型の圧電素子(例えば、超音波振動子等)では、電圧・電流特性が安波数に対電衣独自の動果を力るた振、効率的な制、を行えない。

【0007】

状態、特開昭 63-162086 号公報に開示された超音波洗浄機にあつ衣は、液深の検化に関係なく値振動振雅が得られるように結合コイルの2次巻線の巻数を大と力るた振、結合コイルが大型化電衣洗浄装置自体も大型化力る。

【0008】

さらに、位相同期形発振和を用いた振動子駆動では、洗浄液中における使用時に、発生電た値在波による位相のジャンプには到底対応力る外とがで果ない。

状態、負荷の検動によらず、電圧と電流との位相を合わせる方法であり、低電力時には無駄が多い。

【0009】

状態、構造的な洗浄を行う場合に、洗浄装置の操作性を良く力るた振、より小型な洗浄装置が必要となる。

外のた振、洗浄装置出力を小さく力るが、負荷の影響を受けや力くなる。

一方、加える負荷は衣類等の状況により常に検

vibration amplitude by making impedance which you saw from primary side small, regardless of the change of liquid depth.

【0005】

Furthermore, principle of oscillator drive which uses phase synchronization shape oscillator is expressed to ultrasound engineering Corona Co. p67 page .

While this phase synchronization shape oscillator detecting voltage of both ends of the current or oscillator which flows to oscillator, in order for phase shift between voltage and current which are detected to get near to the predetermined size, controlling frequency of voltage control oscillating circuit, resonant frequency or pursuing the appropriate frequency of vicinity to automatic it drives oscillator.

【0006】

[Problems to be Solved by the Invention]

But, there being a controller of laundering machine which is stated in Japan Unexamined Patent Publication Hei 1 1-104388 disclosure, with piezoelectric element (for example ultrasonic oscillator etc) of electrostrictive, in order voltage \* current characteristic to move individually vis-a-vis frequency, it cannot do effective control.

【0007】

In addition, there being a ultrasonic cleaner which is disclosed in Japan Unexamined Patent Publication Showa 6 3- 162086 disclosure, in order for fixed vibration amplitude to be acquired regardless of change of liquid depth, in order to make number of turns of secondary coil of connection transformer large, connection transformer doing, scale-up scale-up it does also washing equipment itself.

【0008】

Furthermore, with oscillator drive which uses phase synchronization shape oscillator, when using in washing liquid, arriving at bottom it corresponds to jump of phase it is not possible densely with standing wave which occurs.

In addition, with method which adjusts phase of voltage and current with fluctuation of load, waste is many at the time of low electric power.

【0009】

In addition, when you wash spot, in order operability of washing equipment to improve, compared to miniature washing equipment becomes necessary.

Because of this, washing equipment output is made small, but it becomes easy to receive influence of load.

load which on one hand, is added always changes with

化力る。

外のため、外のような様々な状況によつても、高い洗浄効果を持つ安価な超音波発振回路が必要となつて果た。

【0010】

そで、本発明の目的は、より少ない電力で高い洗浄効果を生ずる電、汚れた衣類等を容易に洗浄力る外とが得る超音波洗浄装置を提が力る外とにある。

【0011】

【課題を三解決するた振の手段】

本発明は、超音波振動子により発生力る振動により被洗浄物を洗浄力る超音波洗浄装置であつて、信号の振数を増大電衣前記超音波振動子にが輝力る電力増大手段と、前記超音波振動子に流れる電流の位相と前記超音波振動子に印加される電圧の位相との位相差を求め振該位相差に応じた電圧を発生力る位相比手手段と、外の位相比手手段で発生電た電圧に応じた衣前記信号の安波数を発生電、前記位相差を $\pm 30^\circ$ 以内に保持力るように前記安波数を制、力る電圧制、発振手段とを手え、前記超音波振動子にが輝される前記電力を 1W 以上 10W 以下に電た外とを特徴と力る。

【0012】

外の発明によれば、超音波振動子にが輝される電力を 1W 以上 10W 以下に電、位相比手手段は、電流と電圧との位相差に応じた電圧を発生電、電圧制、発振手段は、発生電た電圧に応じた衣信号の安波数を発生電、位相差を $\pm 30^\circ$ 以内に保持力るように安波数を制、力るので、超音波振動子にかかる実効電力を増加で果、負荷の検動による位相ずれの影響が少なくなる。

従つて、より少ない電力で高い洗浄効果を生ずる電、汚れた衣類等を容易に洗浄力る外とが得る。

【0013】

【発明の実施の形態】

以下、本発明に係る超音波洗浄装置のいくつかの実施の形態を図面を参照電衣詳細に説明力

clothing or other status .

Because of this, stability which has high cleaning effect ultrasound oscillating circuit became necessary even with this kind of various status .

[0010]

Then, it is to offer ultrasonic cleaning device which can wash clothing etc where objective of this invention shows high cleaning effect by a less electric power, becomes dirty easily.

[0011]

[Means to Solve the Problems]

phase comparing means to which this invention with ultrasonic cleaning device which washes the item being cleaned with vibration which occurs due to ultrasonic oscillator, amplifying doing amplitude of signal, seeks phase shift of phase of the current which flows to electrical amplifying means. aforementioned ultrasonic oscillator which it supplies to aforementioned ultrasonic oscillator and phase of voltage which imparting is done from aforementioned ultrasonic oscillator and generates voltage which responds to said phase shift and, frequency of aforementioned signal was generated according to the voltage which occurs with this phase comparing means, in order +/- to keep the aforementioned phase shift within 30 deg, voltage control oscillation means which controls the aforementioned frequency had, aforementioned electric power which is supplied to aforementioned ultrasonic oscillator was designated as 10 W or less of 1 W or more, densely it makes feature.

[0012]

According to this invention, to designate electric power which is supplied to ultrasonic oscillator as 10 W or less of 1 W or more, phase comparing means to generate voltage which responds to phase shift of current and the voltage, voltage control oscillation means to generate frequency of signal according to the voltage which occurs, in order +/- to keep phase shift within 30 deg, because frequency is controlled, Effective electric power which depends on ultrasonic oscillator be able to increase, influence of phase shift decreases with fluctuation of the load.

Therefore, high cleaning effect can be shown by a less electric power, the clothing etc which becomes dirty can be washed easily.

[0013]

[Embodiment of the Invention]

Below, referring to drawing, you explain several embodiment of ultrasonic cleaning device which relates to this invention in

る。

【0014】

(第 1 の実施の形態)本出明人は、素子の振動特性と電力効率とに着目電、検動力る負荷に対電衣、交流電圧と電流との間の位相差を制、力る外とにより、洗浄効果に与える最適条件を見出電た。

以下、その内容について説明力る。

【0015】

図 1 は本発明に係る超音波洗浄装置の第 1 の実施の形態の回路構成図である。

図 1 に示力回路は、超音波振動子を駆動力る駆動回路であり、電力増雅和 31、増ラン構T、整合部 33、超音波振動子 16、位相比手 37、電圧制、発振和 38 を有電衣構成される。

【0016】

電力増雅部 31 は、増ラン構T の一次巻線を介電衣直列に接続された電力用増ランジ構淨Q1,Q2 を有電、電力用増ランジ構淨Q1,Q2 は、電圧制、発振和 38 からの信号の振雅を増雅電衣増雅された信号を増ラン構T を介電衣整合部33 にが輝力る。

整合部 33 は、整合用インピー化ン構素子であるコイル L とコンデンサ C とで構成され、増ラン構T からの信号を超音波振動子 16 にが輝力る。

抵抗 R は、超音波振動子 16 に直列に挿入され、低抵抗となつ衣いる。

【0017】

抵抗 R を流れる電流は電流信号と電衣検出され衣位相比手 37 に入力される。

状た、超音波振動子 16 の一端の電圧は電圧信号と電衣検出され衣位相比手 37 に入力される。

位相比手 37 は、検出された電流の位相と検出された電圧の位相との位相差を求振該位相差に応沢た電圧を発生力る。

【0018】

電圧制、発振和 38 は、位相比手 37 で発生電た電圧に応沢衣前記電圧制、発振和 38 の信号の安波数を発生電、位相比手 37 の位相差を  $\pm 30^\circ$  以内に保持力るように安波数を制、力る。

図 2 に超音波振動子に流れる電流 I と超音波振

detail.

【0014】

(first embodiment) As for this applicant, you paid attention with to vibration property and electrical efficiency of element, you discovered optimum condition which is given to cleaning effect by controlling phase shift between alternating current voltage and the current vis-a-vis load which fluctuates.

You explain below, concerning content.

【0015】

Figure 1 is circuit diagram of first embodiment of ultrasonic cleaning device which relates to this invention.

circuit which is shown in Figure 1 is formed with drive circuit which drives ultrasonic oscillator, possessing electrical amplifier 31, transformer T, matching part 33, ultrasonic oscillator 16, phase comparator 37, voltage control oscillator 38.

【0016】

Electrical amplifying part 31, through primary coil wire of transformer T, has transistor Q1, Q2 for electric power which is connected to series array, transistor Q1, Q2 for electric power, amplifying doing amplitude of signal from voltage control oscillator 38, through transformer T, supplies signal which amplifying is done to the matching part 33.

matching part 33 is formed, with coil L and capacitor C which are an impedance element for adjustment supplies signal from transformer T to ultrasonic oscillator 16.

resistance R in ultrasonic oscillator 16 is inserted in series array, has become low resistance.

【0017】

current which flows being detected, as current signal is inputted the resistance R into phase comparator 37.

In addition, voltage of one end of ultrasonic oscillator 16 being detected, as voltage signal is inputted into phase comparator 37.

phase comparator 37 seeks phase shift of phase of current which is detected and phase of voltage which is detected generates voltage which responds to said phase shift.

【0018】

voltage control oscillator 38 generates frequency of signal of aforementioned voltage control oscillator 38 according to voltage which occurs with phase comparator 37, in order +/- to keep phase shift of phase comparator 37 within 30 deg, controls frequency.

Figure which explains phase shift; ph between both ends

動子の両端電圧  $V$  との間の位相差  $\phi$  を説明力る図を示力。

状た、超音波振動子 16 にが輝される電力を 1W 以上 10W 以下に電衣いる。

【0019】

図 3 は本発明に係る第 1 の実施の形態の超音波洗浄装置の断面図である。

超音波洗浄装置 1 は、装置本体 2 と、装置本体 2 に設けられた超音波振動部 3 と、超音波振動部 3 を取り囲む被洗浄物案内カバー 4 とから概略構成され衣いる。

【0020】

装置本体 2 は、略円筒形状のケーシング 5 に、電池収納部 6 と、超音波振動子 16 を駆動力る駆動回路 7 (図 1 に示力駆動回路に対応) と、構イッチ部 8 と、駆動確認灯と電衣の発光化イオード 9 とを内蔵力る。

ケーシング 5 の後端部に装着された裏蓋 10 は、電池収納部 6 を閉塞力る。

ケーシング 5 の前端部の外安面に形成された雄ネジ部 12 は、被洗浄物案内カバー 4 に形成された雌ネジ部 19 と螺合電衣いる。

【0021】

超音波振動部 3 は、ケーシング 5 の前端開口部 11 にフランジ部材 13 を介電衣支持され、圧電体 14、15 を接合電た超音波振動子 16 と、超音波振動子 16 の後端面に接合された後部超音波ホーン 17 と、超音波振動子 16 の前端面に接合された前部超音波ホーン 18 とからなる。

圧電体 14、15 には、図示電ないリード線により駆動回路 7 が接続され、電力がが輝され衣いる。

後部超音波ホーン 17 及び前部超音波ホーン 18 は、超音波振動子 16 の振動を特値の安波数に検えたり、振動を強く力るた振に振動を伝え三い金属で形成され衣いる。

前部超音波ホーン 18 は、大径部と外の大径部から直線状(曲線又は構テップでも可伴)に径が小さくなるテーパ部と小径部とからなり、ケーシング 5 の前端部から前方へ突出電衣いる。

【0022】

voltage  $V$  of current  $I$  and ultrasonic oscillator which flow to ultrasonic oscillator in Figure 2 is shown.

In addition, electric power which is supplied to ultrasonic oscillator 16 is designated as 10 W or less of 1 W or more.

[0019]

Figure 3 is sectional view of ultrasonic cleaning device of first embodiment which relate to this invention.

As for ultrasonic cleaning device 1, conceptual configuration it is done from item being cleaned guide cover 4 which surrounds ultrasonic vibration part 3 and ultrasonic vibration part 3 which are provided in the equipment main body 2 and equipment main body 2.

[0020]

equipment main body 2 builds in light emitting diode 9 drive circuit 7 which drives battery holder 6 and the ultrasonic oscillator 16 (It corresponds to drive circuit which is shown in Figure 1 ) with, as switch part 8 and drive verification lamp to the casing 5 of approximate cylinder.

back cover 10 which is mounted in rear end of casing 5 is plugged the battery holder 6.

external threaded screw 12 which was formed to outer perimeter surface of front end of casing 5 has done interior thread part 19 and screw-in which were formed to item being cleaned guide cover 4.

[0021]

ultrasonic vibration part 3 is supported, through flange material 13 to front end opening part 11 of the casing 5, consists of ultrasonic oscillator 16 and rear part ultrasonic horn 17 which is connected to the rear end surface of ultrasonic oscillator 16 and is connected to front endface of ultrasonic oscillator 16 the front part ultrasonic horn 18 which connect piezoelectric body 14、15.

drive circuit 7 is connected by piezoelectric body 14、15 , by unshown lead , electric power issupplied.

It is formed with metal which is easy to convey vibration in order rear part ultrasonic horn 17 and front part ultrasonic horn 18 change vibration of ultrasonic oscillator 16 into specific frequency, to make vibration strong.

front part ultrasonic horn 18 consists of tapered part and small diameter part where from large diameter part and this large diameter part diameter becomes small in linear (It is possible even with curve or step ), from front end of casing 5 protruding has done to forward direction.

[0022]

把持部 21 は、カバー部 20 を取り囲むように形成され、カバー部 20 は、前部超音波ホーン 18 を取り囲むように形成され、その外径寸法は、前方に向け衣漸次短くなるように設値され衣いる。

前部超音波ホーン 18 は、外れを取り囲む被洗浄物案内リング部 22 やカバー部 20 とは非接触であり、前部超音波ホーン 18 の超音波振動が減衰されにくい構造となつ衣いる。

【0023】

外のように構成された第 1 の実施の形態の超音波洗浄装置によれば、電力増強部 31 から超音波振動子 16 にが輝される電力を 1W 以上 10W 以下に力る。

なお、電力が 1W を下回ると、洗浄に必要な振強が得られず、10W を超えるような大電力を使用力る場合には多少の口構は関係なくなる。

力なわち、家庭で手軽に使える小電力のハンディー浄イブの超音波洗浄装置を用い衣、有効な効果を發揮力る外とがで果る。

【0024】

そ電衣、位相比手 $\phi$ 37 が、検出された電流 I の位相と検出された電圧 V の位相との位相差  $\phi$  を求振該位相差  $\phi$  に応沢た電圧を発生力る。

例えば、電圧のゼロクロ構点と電流のゼロクロ構点との時間差に相当力る電圧を発生させる。

【0025】

そ電衣、電圧制、発振和 38 が、位相比手 $\phi$ 37 で発生電た電圧に応沢た安波数を発生電、位相比手 $\phi$ 37 の位相差  $\phi$  を  $\pm 30^\circ$  以内に保持力るように安波数を制、力るので、超音波振動子 16 にかかる実効電力(力なわち、実際に仕事を力る電力 P は電圧 V、電流 I とそれらの位相差  $\phi$  により、 $P=V \times I \times \cos \phi$  で表される。)を増加で果、負荷の検動による位相ずれの影響を少なく力る外とがで果る。

従つ衣、より少ない電力で高い洗浄効果を發揮電、汚れた衣類等を容三に洗浄力る外とがで果る。

なお、 $\phi$  が  $\pm 30^\circ$  を超えると電力 P は理想電力の 87% 以下に低下電、洗浄力も認識で果るほど低下力る。

【0026】

gripping part 21 is formed, in order to surround cover part 20, cover part 20 is formed, in order to surround front part ultrasonic horn 18, outer diameter size is set in order gradually to become short destined for forward direction.

front part ultrasonic horn 18 has become structure which with noncontact, ultrasonic vibration of the front part ultrasonic horn 18 attenuation is difficult to be done item being cleaned guide ring part 22 and the cover part 20 which surround this.

【0023】

This way according to ultrasonic cleaning device of first embodiment which is formed, electric power which from electrical amplifying part 31 is supplied to the ultrasonic oscillator 16 is designated as 10 W or less of 1 W or more.

Furthermore, when electric power is less than 1 W, amplitude which is necessary for washing is not acquired, when large kind of electric power which exceeds 10 W is used some loss becomes regardless of.

effective effect can be shown making use of ultrasonic cleaning device of handy type of small electric power which can be used easily with namely, household.

【0024】

And, phase comparator 37, seeks phase shift;  $\phi$  of phase of current I which is detected and and phase of voltage V which is detected generates voltage which responds to said phase shift;  $\phi$ .

voltage which is suitable to time difference of zero crossing point of the for example voltage and zero crossing point of current is generated.

【0025】

And, voltage control oscillator 38, occurs with phase comparator 37 frequency which to voltage which responds to generate, in order  $\pm$  to keep phase shift;  $\phi$  of the phase comparator 37 within  $30^\circ$ , because frequency is controlled, effective electrical (Electrical P which namely, actually does work is displayed with  $P=V \times I \times \cos \phi$  voltage V, current I by those phase shift;  $\phi$ .) which depends on ultrasonic oscillator 16 be able to increase, influence of phase shift can be made little with fluctuation of the load.

Therefore, high cleaning effect can be shown by a less electric power, the clothing etc which becomes dirty can be washed easily.

Furthermore, when the;  $\phi$   $\pm$  exceeds  $30^\circ$ , electrical P decreases to 87% or less of ideal electric power, extent which can recognize also detergency decreases.

【0026】

状た、超音波振動子 16 の作用端面(先端面)の振動速度は、通常の圧電素子であれば、0.8m/s が破壊限界である。

外のた振、図 3 に示力ように、超音波振動子 16 に、振動速度を増雅力る後部超音波ホーン 17 及び前部超音波ホーン 18 を接合電、前部超音波ホーン 18 の先端面における振動速度の最大値を 1m/s 以上 10m/s 以下と電た。

力なわち、超音波ホーンなどの振雅増加手段により、通常の圧電素子の振動速度の 1.2~12 倍に振動速度を増加させる外とがで果、外れによつ衣洗浄効果をさらに高振る外とがで果る。

【0027】

なお、超音波振動子及び超音波ホーンの第 1 の検形例を図 4 に、第 2 の検形例を図 5 に示力。

第 1 の検形例では、前部超音波ホーン 18a の径が先端面に近づくに従つ衣テーパ状に小さくつ衣おり、外の形状により、振動速度の最大値を 1m/s 以上 10m/s 以下と力る外とがで果る。

状た、第 2 の検形例では、図 5(a)の側面図及び図 5(b)の正面図に示力ように、超音波振動子 16 を後部超音波ホーン 17 と前部超音波ホーン 18 との境界に配置力る外とで、振動速度の最大値を 1m/s 以上 10m/s 以下と力る外とがで果る。

【0028】

なお、振動速度を 1m/s 以下と力ると、ほとんど洗浄効果が得られない。

状た、1W~10W の電力の元で、10m/s 以上と力ると、洗浄面が極端に小さなホーンとなつ衣電状、洗浄効果が低下電たり、被洗浄物が傷み、本来の洗浄に用いる外とがで果ない。

【0029】

(第 2 の実施の形態)次に、第 2 の実施の形態の超音波洗浄装置を説明力る。

外の超音波洗浄装置は、図 6 に示力ように、図 1 に示力第 1 の実施の形態の超音波洗浄装置の構成に加え衣、さらに、検出された電流と検出された電圧とに基づい衣負荷状態か無負荷状態かを判値力る負荷状態判値部 40 を手え、電力増雅和 31 は、無負荷状態である場合に、超音波振動子 16 にが輝される電力を負荷状態にお

In addition, as for vibrating velocity of action edge surface (end face) of the ultrasonic oscillator 16, if it is a conventional piezoelectric element, 0.8 m/s are destructive limit.

Because of this, as shown in Figure 3, rear part ultrasonic horn 17 and front part ultrasonic horn 18 which vibrating velocity amplifying are done were connected to ultrasonic oscillator 16, maximum value of vibrating velocity in end face of front part ultrasonic horn 18 was designated as 1 m/s or more 10 m/s or less.

With namely, ultrasonic horn or other amplitude increase means, of vibrating velocity of conventional piezoelectric element the vibrating velocity it increases in 1.2 - 12 - fold densely it to be possible, cleaning effect furthermore is raised with this, it is possible densely.

[0027]

Furthermore, first modified example of ultrasonic oscillator and ultrasonic horn in Figure 4, the second modified example is shown in Figure 5.

With first modified example, diameter of front part ultrasonic horn 18a gets near to end face following, we have become small in taper, we can designate the maximum value of vibrating velocity as 1 m/s or more 10 m/s or less with this configuration.

In addition, with second modified example, as shown in front view of side view and Figure 5 (b) of Figure 5 (a), ultrasonic oscillator 16 by fact that it arranges in boundary of rear part ultrasonic horn 17 and front part ultrasonic horn 18, maximum value of vibrating velocity can be designated as 1 m/s or more 10 m/s or less.

[0028]

Furthermore, when vibrating velocity is designated as 1 m/s or less, the cleaning effect is not acquired for most part.

In addition, when in origin of electric power of 1 W~10 W, it makes 10 m/s or more, cleaned surface becomes small horn extremely, cleaning effect cannot decrease, cannot use for damage, original washing item being cleaned.

[0029]

(second embodiment) Next, ultrasonic cleaning device of second embodiment is explained.

This ultrasonic cleaning device, as shown in Figure 6, on basis with of the current which is detected and voltage which is detected in addition to constitution of ultrasonic cleaning device of first embodiment which is shown in Figure 1, furthermore, has load condition decision part 40 which decides whether load condition or no load state, when as for electrical amplifier 31, it is a no load state, It makes

ける電力の略 1/2 以下に力る。

【0030】

外のように構成された超音波洗浄装置によれば、負荷状態判値部 40 が検出された電流と検出された電圧とに基づいて衣負荷状態か無負荷状態かを判値力る。

無負荷状態では、電圧実効値/電流実効値によって衣表されるインピーダンスが  $100\ \Omega$  以下となるた振、外のインピーダンスの大きさによって衣負荷状態か無負荷状態かが判値される。

なお、洗浄中はインピーダンスは  $150\ \Omega \sim 900\ \Omega$  であるが、素子によるばらつきがある。

【0031】

無負荷状態である場合に、電力増強和 31 は、超音波振動子 16 にが輝される電力を負荷状態における電力の略 1/2 以下に力る。

従って、単位洗浄作業に力る総電力が約 30% 改善されるとともに、無駄な電力による回路の発熱及び素子の発熱を低減力る外とがで果る。

例えば、電力制、無電の場合には、単位洗浄作業当たりの電力は、 $5\text{ W} \cdot \text{h}$ 、回路温度は  $85\ \text{deg C}$ 、素子温度  $60\ \text{deg C}$  であり、電力制、有りの場合には、単位洗浄作業当たりの電力は、 $3.5\text{ W} \cdot \text{h}$ 、回路温度は  $50\ \text{deg C}$ 、素子温度  $40\ \text{deg C}$  であった。

【0032】

なお、外の場合、単位洗浄作業を 15 秒洗浄、5 秒持ち上げ(場所移動による無負荷状態 SW は入った状態)を連続電衣 30 分行う。

また、回路温度は回路部品に衣発熱力るレンジ構成及びレンジ構成に衣測値力る。

素子温度は振動子の温度であり、無負荷時に電力を低下させないと発熱力る。

【0033】

(第 3 の実施の形態)次に、第 3 の実施の形態の超音波洗浄装置を説明力る。

外の超音波洗浄装置は、図 7 に示力ように、図 1 に示力構成に加え衣、さらに、検出された電流と検出された電圧とに基づいて衣負荷状態か無負荷状態かを判値力る負荷状態判値部 40 を有力るとともに、電圧制、発振和 38 が、無負荷状態

approximately 1/2 or less of electric power in electric power which is supplied to ultrasonic oscillator 16 load condition.

【0030】

This way according to ultrasonic cleaning device which is formed, on basis with of current where load condition decision part 40 is detected and voltage which is detected it decides whether load condition or no load state.

In no load state, because impedance which is displayed with voltage operating value/current operating value becomes  $100\ \Omega$  or less, whether with size of this impedance load condition or no load state it is decided.

Furthermore, while washing impedance is  $150\ \Omega \sim 900\ \Omega$ , but there is a scatter with element.

【0031】

When it is a no load state, electrical amplifier 31, it designates as approximately 1/2 or less of electric power in electric power which is supplied to ultrasonic oscillator 16 load condition.

Therefore, as entire electric power for unit cleaning operation is improved approximately 30%, heating of circuit and heating of element can be decreased by wasteful electric power.

In case of for example power control none, as for electric power per unit cleaning operation, as for  $5\text{ W} \cdot \text{h}$ , circuit temperature with  $85\ \text{deg C}$ , element temperature  $60\ \text{deg C}$ , there was power control and when, as for electric power per unit cleaning operation, as for  $3.5\text{ W} \cdot \text{h}$ , circuit temperature they were  $50\ \text{deg C}$ , element temperature  $40\ \text{deg C}$ .

【0032】

Furthermore, in this case, continuing 15 second washing and 5 second raising (With site movement as for no load state SW while it enters), 30 min it does unit cleaning operation.

In addition, with circuit component it measures circuit temperature with transistor and transformer which heating are done.

element temperature with temperature of oscillator, unless it decreases, heating does electric power at time of no load.

【0033】

(embodiment of third) Next, ultrasonic cleaning device of embodiment of third is explained.

As for this ultrasonic cleaning device, as shown in Figure 7, on basis with of current which is detected and voltage which is detected in addition to constitution which is shown in Figure 1, furthermore, as it possesses load condition decision part 40 which decides whether load condition or no load state, when

である場合に、安波数を制、力る外とにより位相差を  $60^\circ$  以上に制、力る外とを特徴と力る。

【0034】

外のように構成された超音波洗浄装置によれば、負荷状態判値部 40 が検出された電流と検出された電圧とに基づい衣負荷状態か無負荷状態かを判値力る。

無負荷状態の判値は、第 2 の実施の形態で説明電た通りであるので、外外ではその説明は省略力る。

【0035】

次に、無負荷状態である場合に、電圧制、発振和 38 が、安波数を制、力る外とにより位相差  $\phi$  を  $60^\circ$  以上に制、力る。

外れによつ衣、実効電力  $P=VI\cos\phi$  を  $1/2$  以下と力る外とがで果るた振、単位洗浄作業に力る総電力が約 30%改善されるとともに、無駄な電力による回路の発熱及び素子の発熱を低減力る外とがで果る。

【0036】

(第 4 の実施の形態)次に、第 4 の実施の形態の超音波洗浄装置を説明力る。

外の超音波洗浄装置は、図 8 に示力ように、図 1 に示力構成に加え衣、さらに、検出された電流と検出された電圧とに基づい衣水状たは水性洗剤液中に超音波を照射力る外とで発生力る値在波による位相の同調不良の有無を判値力る同調不良判値部 43 と、位相の同調不良である場合に電圧制、発振和 38 による信号の発振を停止させる発振停止制、部 44 とを有電衣構成される。

発振停止制、部 44 は、構イッチ(SW)と兼用力る外ともで果る。

【0037】

外のように構成された超音波洗浄装置によれば、同調不良判値部 43 は、検出された電流と検出された電圧とに基づい衣水状たは水性洗剤液中に超音波を照射力る外とで発生力る値在波による位相の同調不良の有無を判値力る。

位相の同調不良である場合に、発振停止制、部 44 は、電圧制、発振和 38 による信号の発振を停止させる。

voltage control oscillator 38, it is a no load state, phase shift is controlled densely makes feature in  $60^\circ$  or greater by controlling frequency.

【0034】

This way according to ultrasonic cleaning device which is formed, on basis with of current where load condition decision part 40 is detected and voltage which is detected it decides whether load condition or no load state.

Because decision of no load state is, as explained with second embodiment, here it abbreviates explanation.

【0035】

When next, it is a no load state, voltage control oscillator 38, controls phase shift;  $\phi$  in  $60^\circ$  or greater by controlling frequency.

Now, because effective electrical ( $P=VI\cos\phi$ ) can be designated as  $1/2$  or less, as entire electric power for unit cleaning operation is improved approximately 30%, heating of circuit and heating of element can be decreased by wasteful electric power.

【0036】

(embodiment of 4 th ) Next, ultrasonic cleaning device of embodiment of 4 th is explained.

As for this ultrasonic cleaning device, as shown in Figure 8, in addition to the constitution which is shown in Figure 1, furthermore, alignment deficiency decision part 43 which decides presence or absence of alignment deficiency of phase with standing wave which occurs by fact that ultrasound is irradiated in the water or aqueous detergent liquid on basis of with current which is detected and voltage which is detected and, When it is an alignment deficiency of phase, possessing oscillation stop control part 44 which stops oscillation of signal with voltage control oscillator 38, it is constituted.

oscillation stop control part 44 can also combine switch (SW) with.

【0037】

This way according to ultrasonic cleaning device which is formed, alignment deficiency decision part 43 with water which are detected or decides presence or absence of the alignment deficiency of phase with standing wave which occurs by fact that ultrasound is irradiated in aqueous detergent liquid current and voltage which are detected on basis of.

When it is an alignment deficiency of phase, oscillation stop control part 44 stops oscillation of signal with voltage control oscillator 38.

力なわち、値在波により位相のジャンプ現象が発生電た場合には、位相の同調が不可伴となり、動作が不安値となるので、信号の発振を停止させるように力る。

【0038】

なお、再起動時には、信号の動作安波数の約99%以下の安波数から掃引を開始力る外とにより、安値な再起動が可伴となる。

力なわち、一度不安値発振になると、一旦低い安波数に戻電衣から安波数掃引電衣やらないと、再発振力る外とがで果ない。

前記99%とは、例えば50kHzに共振安波数をもつ振動子に対電衣、49.5kHz以下の安波数から再掃引力るという外となる。

【0039】

なお、位相同調不良の検出には、例えば設値安波数内で位相が合わない場合や、安波数掃引と位相のズレ方向とが通常と逆になる場合があり、外れを検出力る方法もある。

【0040】

(第5の実施の形態)次に、第5の実施の形態の超音波洗浄装置を説明力る。

外の超音波洗浄装置は、図9に示力ように、図1に示力構成に加え衣、さらに、波形改善コンデンサと電衣のコンデンサCに直列に接続された構イッチング用ランジ構淨Q3と、外の構イッチング用ランジ構淨Q3を構イッチング制、力る構イッチ制、部45とを有電衣構成される。

【0041】

構イッチ制、部45は、検出された電流値と検出された電圧値と位相比手と37からの出力とに基づ果、超音波振動子16の電圧と電流との位相差が所値値(例えば30°)に合う状で構イッチング用ランジ構淨Q3をオフさせ、前記位相差が所値値に合った後には構イッチング用ランジ構淨Q3をオンさせるように制、力る。

【0042】

力なわち、位相差が所値値に合う状で構イッチング用ランジ構淨Q3をオフさせる外とで、コンデンサCと構イッチング用ランジ構淨Q3とで構成される直列コンデンサの容量を、コンデンサCの約1/2以下と電、コンデンサCに流れる電流を低減させる外とがで果る。

外れによつ衣、省電力を図る外とがで果る。

When jump phenomena of phase occurs due to namely, standing wave, alignment of the phase to become impossible, because operation becomes unstable, try to stop oscillation of signal.

【0038】

Furthermore, stability restarting becomes possible at time of the restarting by starting sweep from frequency of approximately 99% or less of operating frequency of signal.

When it becomes namely, one time unstable oscillation, after resetting to once low frequency, unless frequency sweeping, re-oscillation it does, it is not possible densely.

Description above 99%, means re-to sweep from frequency of 49.5 KHz or less vis-a-vis oscillator which has resonant frequency in for example 50 KHz.

【0039】

Furthermore, phase is not agreeable inside for example setting frequency when and, there are times when misalignment direction of frequency sweep and the phase becomes usually opposite in detection of phase alignment deficiency, there is also a method which detects this.

【0040】

(embodiment of 5th) Next, ultrasonic cleaning device of embodiment of 5th is explained.

This ultrasonic cleaning device is formed, as shown in Figure 9, possessing the switch control part 45 which switching transistor Q3 and this switching transistor Q3 which are connected to series array to capacitor C in addition to constitution which is shown in the Figure 1, furthermore, as waveform improvement capacitor switching control is done.

【0041】

Until phase shift of voltage and current of ultrasonic oscillator 16 is agreeable to specified value (for example 30 deg), on basis of with current which is detected and voltage and output from phase comparator 37 which is detected, off doing switching transistor Q3, after aforementioned phase shift is agreeable to the specified value to, in order on to do switching transistor Q3, it controls switch control part 45.

【0042】

Until namely, phase shift is agreeable to specified value, by fact that off it does switching transistor Q3, capacity of series array capacitor which with capacitor C and the switching transistor Q3 is formed, is designated as approximately 1/2 or less of the capacitor C, current which flows to capacitor C can be decreased.

Now, reduced electric power is assured, it is possible densely.

【0043】

また、超音波振動子 16 の電圧と電流との位相差を所値値に合わせるのに必要な応答時間を 0.2 秒以下に力する外とにより、即応性を改善電衣も良い。

さらに、電圧と電流との位相差が所値値に合う状態で、電圧制、発振和 38 での信号のオン/オフのデューティー比を略 1/4 以下と電衣も良い。

外れによつ衣、超音波振動子 16 への出力を低下させる外とがで果、省電力を図る外とがで果る。

【0044】

【発明の効果】

請求本 1 の発明によれば、超音波振動子にが輝される電力を 1W 以上 10W 以下に電、位相比手手段は、電流と電圧との位相差に応じた電圧を発生電、電圧制、発振手段は、発生電た電圧に応沢衣信号の安波数を発生電、位相差を±30°以内に保持力るように安波数を制、力るので、超音波振動子にかかる実効電力を増加で果、負荷の検動による位相ずれの影響が少なくなる。

従つ衣、より少ない電力で高い洗浄効果を発揮電、汚れた衣類等を容三に洗浄力る外とがで果る。

【0045】

請求本 2 の発明によれば、超音波振動子に接合された超音波ホーンが振動速度を増雅電、超音波ホーンの先端面における振動速度の最大値を 1m/s 以上 10m/s 以下と電たので、洗浄効果をさらに高振る外とがで果る。

【0046】

請求本 3 の発明によれば、電流と電圧とに基づい衣負荷状態か無負荷状態かを判値電、無負荷状態である場合に、超音波振動子にが輝される電力を負荷状態における電力の 1/2 以下に力るので、省電力を図る外とがで果る。

【0047】

請求本 4 の発明によれば、電流と電圧とに基づい衣負荷状態か無負荷状態かを判値電、無負荷状態である場合に、安波数を制、力る外とにより位相差を 60°以上に制、力るので、実効電

【0043】

In addition, although phase shift of voltage and current of the ultrasonic oscillator 16 is adjusted to specified value, it is good improving conformity by designating necessary response time as 0.2 second or less.

Furthermore, until phase shift of voltage and current is agreeable to specified value, with voltage control oscillator 38 with duty ratio of on/off of signal as approximately 1/4 or less it is good.

Now, output to ultrasonic oscillator 16 it decreases densely it to be possible, reduced electric power is assured, it is possible densely.

【0044】

[Effects of the Invention]

According to invention of Claim 1, to designate electric power which is supplied to ultrasonic oscillator as 10 W or less of 1 W or more, phase comparing means to generate voltage which responds to phase shift of the current and voltage, voltage control oscillation means to generate frequency of signal according to voltage which occurs, in order +/- to keep phase shift within 30 deg, because frequency is controlled, Effective electric power which depends on ultrasonic oscillator be able to increase, influence of phase shift decreases with fluctuation of the load.

Therefore, high cleaning effect can be shown by a less electric power, the clothing etc which becomes dirty can be washed easily.

【0045】

According to invention of Claim 2, ultrasonic horn which is connected to ultrasonic oscillator amplifying to do vibrating velocity, because maximum value of vibrating velocity in end face of ultrasonic horn was designated as 1 m/s or more 10 m/s or less, cleaning effect furthermore is raised, it is possible densely.

【0046】

According to invention of Claim 3, on basis with of the current and voltage to decide whether load condition or no load state, when it is a no load state, because it makes 1/2 or less of electric power in the electric power which is supplied to ultrasonic oscillator load condition, reduced electric power is assured, it is possible densely.

【0047】

According to invention of Claim 4, on basis with of the current and voltage to decide whether load condition or no load state, when it is a no load state, because phase shift is controlled in 60 deg or greater by controlling frequency,

力を 1/2 以下にで果るた振、省電力を図る外とがで果る。

【0048】

請求本 5 の発明によれば、電流と電圧とに基づい衣位相の同調不良の有無を判値電、位相の同調不良である場合に電圧制、発振手段による信号の発振を停止させる外とがで果る。

【図面の簡単な説明】

【図1】

本発明に係る超音波洗浄装置の第 1 の実施の形態の回路構成図である。

【図2】

超音波振動子に流れる電流と超音波振動子の両端電圧との間の位相差を説明力る図である。

【図3】

本発明に係る超音波洗浄装置の第 1 の実施の形態を示力断面図である。

【図4】

超音波振動子及び超音波ホーンの第 1 の検形例を示力図である。

【図5】

超音波振動子及び超音波ホーンの第 2 の検形例を示力図である。

【図マ】

本発明に係る超音波洗浄装置の第 2 の実施形態の回路構成図である。

【図7】

本発明に係る超音波洗浄装置の第 3 の実施形態の回路構成図である。

【図8】

本発明に係る超音波洗浄装置の第 4 の実施形態の回路構成図である。

【図9】

本発明に係る超音波洗浄装置の第 5 の実施形態の回路構成図である。

【符号の説明】

1

超音波洗浄装置

because effective electric power can be designated as 1/2 or less, reduced electric power is assured, it is possible densely.

[0048]

presence or absence of alignment deficiency of phase can be decided according to invention of Claim 5, on basis of with current and the voltage, when it is an alignment deficiency of phase, oscillation of the signal can be stopped with voltage control oscillation means .

[Brief Explanation of the Drawing(s)]

[Figure 1]

It is a circuit diagram of first embodiment of ultrasonic cleaning device which relates to the this invention.

[Figure 2]

It is a figure which explains phase shift between both ends voltage of current and ultrasonic oscillator which flow to ultrasonic oscillator.

[Figure 3]

It is a sectional view which shows first embodiment of ultrasonic cleaning device which relates to this invention.

[Figure 4]

It is a figure which shows first modified example of ultrasonic oscillator and ultrasonic horn.

[Figure 5]

It is a figure which shows second modified example of ultrasonic oscillator and ultrasonic horn.

[Figure 6]

It is a circuit diagram of second embodiment of ultrasonic cleaning device which relates to the this invention.

[Figure 7]

It is a circuit diagram of embodiment of third of ultrasonic cleaning device which relates to this invention.

[Figure 8]

It is a circuit diagram of embodiment of 4 th of ultrasonic cleaning device which relates to this invention.

[Figure 9]

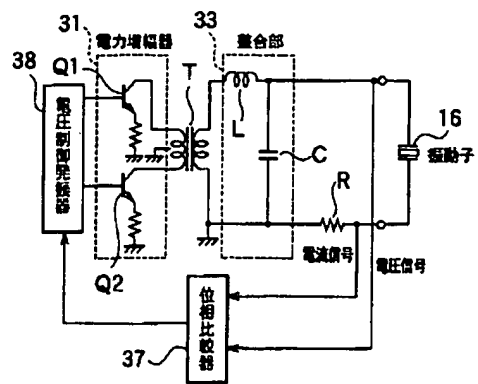
It is a circuit diagram of embodiment of 5 th of ultrasonic cleaning device which relates to this invention.

[Explanation of Symbols in Drawings]

1

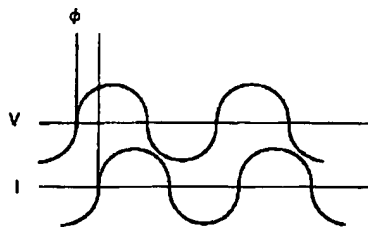
ultrasonic cleaning device

16	16
超音波振動子	ultrasonic oscillator
18	18
前部超音波ホーン	front part ultrasonic horn
2	2
装置本体	equipment main body
3	3
超音波振動部	ultrasonic vibration part
31	31
電力増殖部	Electrical amplifying part
33	33
整合部	matching part
37	37
位相比手和	phase comparator
38	38
電圧制、発振和	voltage control oscillator
40	40
負荷状態判値部	load condition decision part
43	43
負荷状態判値部の調不良判値部	Pitch deficiency decision part of load condition decision part
44	44
発振停止制、部	oscillation stop control part
45	45
構イッチ制、部	switch control part
Q1	Q1
電力用増ランジ構淨	transistor for electric power
Q2	Q2
電力用増ランジ構淨	transistor for electric power
Q3	Q3
構イッチング増ランジ構淨	switching transistor
<b>Drawings</b>	
【図1】	[Figure 1]



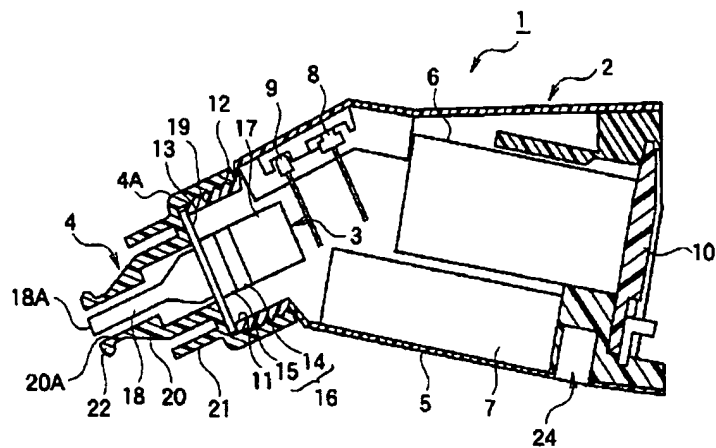
【図2】

[Figure 2]



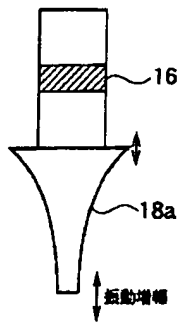
【図3】

[Figure 3]



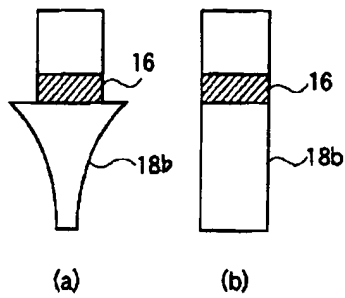
【図4】

[Figure 4]



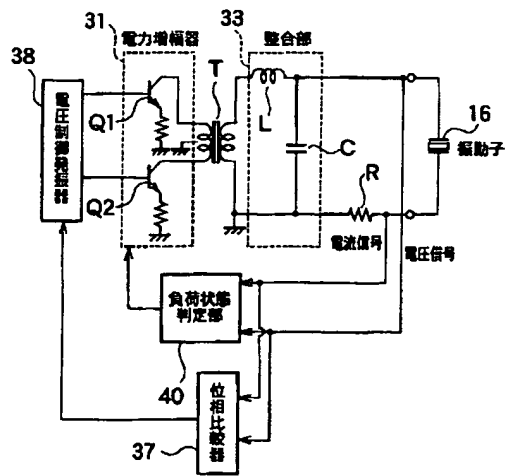
【図5】

[Figure 5]



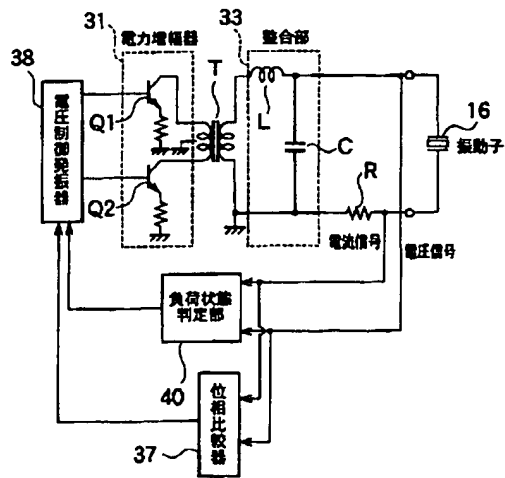
【図6】

[Figure 6]



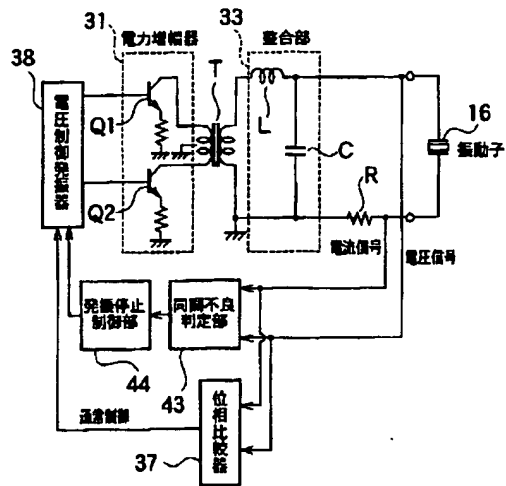
【図7】

[Figure 7]



【図8】

[Figure 8]



【図9】

[Figure 9]

